Continue

Mastering physics answers chapter 17 answers pdf

Physics chapter 17.

The Online Learning Centre provides guidance, tools, and resources for exploring English Essentials Canadian Edition. The platform offers course-wide content, including diagnostic quizzes and an internet primer, accessible through the navigation bar. Chapter-specific content like quizzes and writing exercises can be accessed by choosing a chapter from the pull-down menu. Additionally, the centre offers secure, downloadable supplements, such as PowerPoint presentations and Instructor's Manuals, which can be accessed via the navigation bar. Mastering Physics Solutions: Q.1CQ: The oxygen masks on an airplane are designed to work properly even if they don't fully inflate. This is because the bags expand more at high altitude than low altitude. This explains why the oxygen masks behave in this way. Q.1P (a): There are more molecules of N2 than O2 in one mole. (b): The mass of one mole of N2 is equal to the mass of one mole of O2. Q.2CQ: Operating the furnace in a tightly sealed house increases air pressure due to the heat and gas emissions released by the furnace. This explains how air pressure is affected by furnace operation. Q.2P: Helium has individual atoms, while oxygen is a diatomic gas (contains two atoms). Therefore, one mole of oxygen contains twice as many atoms as one mole of helium. This means there are fewer atoms in one mole of helium compared to oxygen. Q.3CQ: The average velocity of air molecules in the room can't be measured accurately because their motion is random and unpredictable. A balloon left inside a refrigerator would likely experience a decrease in volume due to the lower temperature. Among the given explanations: I. Lowering the temperature of an ideal gas at constant pressure results in a reduced volume. II. The same amount of gas is in the balloon; therefore, its volume remains the same. III. The balloon can expand more in the cool air of the refrigerator, giving an increased volume. Explanation I is correct as it aligns with the principle that lowering the temperature of an ideal gas at constant pressure results in a reduced volume. Regarding changing both the pressure and volume of an ideal gas without altering its average kinetic energy, the answer would be "yes" with a specific example such as using a bike pump to inflate tires while also increasing the air inside them, thereby changing both the pressure and volume without affecting the kinetic energy of the molecules. Two containers holding ideal gases at the same temperature show that container A has twice the volume and half the number of molecules compared to container B. The ratio PA/PB where PA is the pressure in container A and PB is the pressure in container B would be 2:1, indicating that container A's pressure is twice that of container B. At standard temperature and pressure (STP) defined as a temperature of 0°C and a pressure of 101.3 kPa, one mole of an ideal gas occupies approximately 22.4 liters in volume. A camping stove used on a mountaintop barely boils water due to the lower atmospheric pressure. When brought to sea level, it will be able to boil water more easily because of the higher atmospheric pressure at sea level. As air warms from 0°C to 37°C, its volume increases approximately by a factor of 1.29. An autoclave uses high temperatures and pressures to ensure effective sterilization beyond just boiling point due to the principle that increasing both temperature and pressure raises the boiling point of water beyond 100°C at sea level. A bicyclist finds that his tire's absolute pressure increased from 501 kPa in the morning (286 K) to 554 kPa in the afternoon (assuming no expansion). The average kinetic energy of air molecules, however, remains constant due to the ideal gas law not applying directly to the increase in tire pressure. As the temperature of ice increases, it first melts into a liquid and then vaporizes. In contrast, dry ice undergoes a direct phase change from solid to vapor as its temperature rises. To produce liquid carbon dioxide, one could potentially use a process involving pressure or temperature changes. Isopropyl alcohol is used to lower body temperature by rubbing it on patients' skin. This approach works because the alcohol evaporates quickly, absorbing heat and cooling the surrounding area. The Goodyear blimp contains 7023 cubic meters of helium at 285 K and 112 kPa pressure. If we were to find its mass, we would need to consider factors like temperature and pressure. When you toss an ice cube into a pool, the water doesn't instantly reach 0°C. Instead, the ice melts as it absorbs heat from the surrounding water, achieving equilibrium based on the combined energy and mass of both components. A compressed-air tank holds 0.5 cubic meters of air at 285 K and 880 kPa pressure. If released into the atmosphere (101 kPa and 303 K), what volume would the air occupy? In a kitchen, a drop of water evaporates quickly, with only a small fraction of molecules rapidly escaping. This happens because the remaining molecules absorb energy from their surroundings and repeat the process, ultimately causing the entire drop to evaporate. In interstellar space, a typical region might contain 10^6 atoms per cubic meter at 100 K temperature. What is the pressure of this gas? Four ideal gases have different pressures, volumes, and mole numbers: - Gas A: P = 100 kPa, V = 1 m3, n = 10 mol - Gas B: P = 200 kPa, V = 2 m3, n = 20 mol - Gas C: P = 50 kPa, V = 1 m3, n = 50 mol - Gas D: P = 50 kPa, V = 4 m3, n = 5 mol To rank these gases in order of increasing temperature, we should use the ideal gas law: PV = nRT. First, let's calculate the temperatures for each gas: - Gas A: T = (P × V) / (n × R) - Gas B: T = (200 kPa × 2 m3) / (20 mol × R) - Gas C: T = (50 kPa × 1 m3) / (50 mol × R) - Gas D: T = (50 kPa × 4 m3) / (5 mol × R) Since the value of R is constant, we can directly compare the temperature values. By performing these calculations and comparing them, we can determine the order of increasing temperature for the given gases. If we have an ideal gas with three separate processes: (i) constant-temperature expansion that triples its volume, (ii) constant-pressure compression to its initial volume, and (iii) constant-volume increase in pressure to its initial pressure, the end result is the gas returning to its initial state. Gas molecules and their speeds are being discussed, along with various scenarios involving changes in pressure, volume, and temperature. Some key points mentioned include: * Ammonia has an atmosphere of pure ammonia at 0.0 °C. * Oxygen gas is placed in a portable container, and the pressure and average kinetic energy of an oxygen molecule are calculated. * The rms speed of O2 and H2O molecules at given temperatures is compared. * An ideal gas is kept in a container with constant volume and pressure, and changes to the number of molecules and their rms speeds are examined. * A temperature of a gas of CO2 molecules with a certain rms speed is calculated. * Changes in temperature and pressure of a gas due to an increase in its rms speed by 1% are discussed. * The ratio of the rms speeds of two isotopes (235UF6 and 238UF6) at a given temperature is determined. The calculations involve applying principles from physics, particularly the kinetic theory of gases. A brick with faces measuring 1 cm by 2 cm, 2 cm by 3 cm, and 1 cm by 3 cm should be placed on the face with dimensions 1 cm by 2 cm to minimize dimensional change due to its weight. This placement ensures that the brick's weight compresses it the least. A hollow cylindrical rod and a solid one made of the same material have the same length and outer radius, but applying the same force causes different effects in their lengths. The change in the length of the solid rod is less than or equal to the change in the length of the hollow rod because its walls resist compression more effectively. A rock climber's mass can be determined by knowing that a 14 m long rope with an 8.3 mm diameter stretches 4.6 cm under their weight, thus requiring knowledge of the Young’s modulus and how it applies to stretched materials like ropes or muscles. To calculate the Young's modulus for muscle tissue, one must consider its cross-sectional area (47 cm^2) and the force required to stretch it by a certain amount (25 N). The length of the biceps muscle is also essential in this calculation, as it affects how much the muscle will stretch under the given force. The Marianas Trench, at 10.9 Km deep with pressures reaching 1.10 × 108 Pa, poses a significant challenge to objects taken there due to immense pressure. A copper ball of a certain diameter dropped into this environment would experience substantial volume decrease as it compresses under such intense pressure. A steel wire 4.7 m long stretches by 0.11 cm when subjected to 360 N of tension. Determining its diameter involves understanding how Young's modulus relates material properties to physical phenomena like stretching. Adjusting the wire’s diameter can affect how much it stretches, with a decrease potentially leading to less stretch but other factors must be considered for optimal results. An orb weaver spider weighing 0.26 g hangs by one thread that has a Young's modulus of 4.7 × 10^9 N/m^2 and a radius of 9.8 × 10^-6 m. The effect on the thread and how it holds the spider under its weight are crucial in understanding this setup. A problem set in a physics or engineering course is provided, containing multiple questions related to phases and phase changes. The questions cover various topics such as: - The fractional increase in the thread's length caused by a spider - The effect of compressive force on two rods made of different materials (aluminum and brass) - The tension in a piano wire after it has been wrapped around a timing peg - Phase changes, including the formation of ice from water The provided text does not contain any specific information; rather, it lists several questions with solutions marked as "Q.44P" to "Q.58P". Of 9.5 × 10s J is required to convert a block of ice at −15 °C to water at 15 °C. What was the mass of the block of ice? To find the mass, we need to know the specific heat capacity and latent heat of fusion for ice. The energy needed to change the state from solid to liquid (latent heat of fusion) is typically provided in problems like this. Assuming we have these values: - Specific heat capacity of ice = 2 kJ/kg°C - Latent heat of fusion = 334 kJ/kg Given energy Q = 9.5 × 10s J, convert it to Joules: Q = 9500 kJ Q = mL + m * c * ΔT = m(334000) + m * (2000) * (-15 – 25) Solving for m gives us the mass of the block of ice. When calculating the heat released, we need to consider two scenarios: one where liquid water is cooled from 100 °C to 50.0 °C, and another where steam at 100 °C is condensed and then cooled to 50.0 °C. In both cases, we'll use the formula Q = mcΔT for each substance involved in the process, where m is the mass, c is the specific heat capacity (4186 J/kg · K for water), and ΔT is the change in temperature. For part (a) with liquid water: - The initial temperature is 100 °C, and the final temperature is 50.0 °C. - Therefore, ΔT = 100 °C - 50.0 °C = 50.0 °C. - Given that 12.5 g of liquid water is used, Q for water = 12.5 g * 4186 J/kg · K / 1000 kg/g * 50.0 °C. For part (b) with steam: - The initial temperature is also 100 °C, and the final temperature is 50.0 °C. - Hence, ΔT remains 50.0 °C. - Since we are now dealing with steam, which condenses into liquid water at its boiling point of 100 °C, we only need to consider this process as the heat released due to condensation would be equal to that required to cool the resulting liquid down from 100 °C to 50.0 °C. Therefore, Q for steam = Q for water in part (a). Given these calculations, we find that the heat released is the same for both scenarios. To determine the mass of flesh (with a specific heat capacity of 3500 J/kg · K) that can be heated from 37.0 °C to 50.0 °C using the calculated heat: - The temperature difference ΔT = 50.0 °C - 37.0 °C = 13.0 °C. - Therefore, the mass of flesh required would be m = Q / (c * ΔT), where c is the specific heat capacity of flesh. Chapter 17 Phases and Phase Changes presents several problems for solutions. Q.72P: A 0.075-kg ice cube at 0.0 °C is dropped into a Styrofoam cup holding 0.33 kg of water at 1.4 °C. The final temperature of the system needs to be determined along with any remaining ice (if any). The initial temperature of the water that would barely melt all the ice also requires calculation. Q.73P: To keep a barn warm on cold days, a farmer stores 865 kg of warm water in it. The number of hours a 2.00-kilowatt electric heater needs to operate to provide the same amount of heat as the cooling and freezing water should be calculated. Q.74GP: Plastic bubble wrap's effectiveness on a cold day versus a warm day is discussed. This involves explaining whether the bubble wrap would be more effective in maintaining temperature stability during transport. Q.75GP: Two hotel rooms, equal in size and connected by an open door, have one room warmer than the other. The explanation for which room contains more air based on their temperature difference should be provided. Q.76GP: With increasing altitude, expectations about the ratio of oxygen to nitrogen in the atmosphere are examined. This involves explaining whether this ratio would increase, decrease, or stay the same with higher altitudes. Q.77GP: Doubling a gas's Celsius temperature from 100 °C to 200 °C affects its average kinetic energy and speed. Detailed explanations about how these changes occur should be provided for both increased temperature scenarios (in Celsius and Kelvin). Q.78GP: This problem also pertains to the effect of doubling an ideal gas's absolute temperature in Kelvin on its average speed. It involves choosing the best explanation from provided options, which includes understanding the relationship between temperature and kinetic energy or speed. These questions deal with various aspects of phase changes, thermal properties, and gas behavior under different conditions. Solutions to these problems require a good grasp of thermodynamic principles as discussed in Chapter 17 Phases and Phase Changes. **Temperature and Kinetic Theory of Gases** The average speed of gas molecules increases when the temperature is doubled, but by a factor less than 2. A fishing line's Young’s modulus is given as 5.1 × 109 N/m2, with a fish hanging vertically from it out of the water. (a) When the fish is at rest, what fractional increase occurs in the fishing line's length? (b) If the fish moves upward with a constant speed of 1.5 m/s, how does this affect the fishing line's length? (c) What happens to the fishing line’s length when the fish is pulled upward with a constant acceleration of 1.5 m/s2? Temperature change after adding (a) 5.00 × 10^4 J, (b) 1.00 × 10^5 J, and (c) 1.50 × 10^5 J of heat to the system. Students on a picnic bring a cooler with 5.1 kg of ice at -0°C. The cooler has walls that are 3.8 cm thick and made of Styrofoam with a thermal conductivity of 0.030 W/(m · C°). The surface area is 1.5 m^2, and it rests in the shade where the air temperature is 21 °C. (a) How much heat flows into the cooler? (b) How long does it take for the ice to melt? A 5.5-kg block of ice at -1.5°C slides on a surface with a coefficient of kinetic friction equal to 0.062. The initial speed is 6.9 m/s, and its final speed is 5.5 m/s. Assuming all energy dissipated by friction goes into melting some ice, find the mass that melts. The American naturalist Charles William Beebe set a record in 1934 when he dove to 923 m below the ocean's surface. He used a device called the bathysphere with three small ports made of fused quartz. The bathysphere was lowered on a steel cable with a radius of 1.85 cm, carrying oxygen and chemicals. Charles saw creatures during his dives, including a "great red shrimp" that he considered strange like life on Mars. It's worth noting that the original text had some sections removed or rephrased for clarity, while maintaining the core information. The changes were made to ensure the paraphrased text adhered to the requested format and structure, removing unnecessary details while preserving essential points. Charles William Beebe, an American naturalist, achieved a world record in 1934 by diving to a depth of 923 meters below the ocean's surface along with Otis Barton. This notable feat was accomplished just 10 miles off the coast of Bermuda, using a device called the bathysphere, which was designed and built by Barton. The bathysphere was essentially a steel sphere measuring 1.44 meters in diameter, featuring three small ports made of fused quartz. It carried essential supplies such as bottles of oxygen, chemicals to absorb carbon dioxide, and a telephone line for communication with the surface team. Beebe's interest in the ocean depths led him to observe various forms of life during their dives, even witnessing a "creature" explode near the window. Their experiences, though fascinating, were not without risks. On one occasion, water began to steam rapidly into the sphere due to a leaky window seal. However, Beebe displayed exceptional cool-headedness and knowledge of basic physics by realizing that increasing water pressure could force the leaking window into its seals, thereby stopping the leak. At the record depth, the bathysphere experienced an extreme water pressure. The correct answer for this is 92.9 atm. In 1934, American naturalist Charles William Beebe and his colleague Otis Barton set a world record by diving to an astonishing depth of 923 meters below the ocean's surface, just 10 miles off the coast of Bermuda. Their remarkable feat was made possible with a device called the bathysphere, designed and built by Barton himself. The bathysphere was essentially a steel sphere approximately 4.75 feet in diameter, equipped with three small ports made of fused quartz, as well as oxygen bottles, carbon dioxide-absorbing chemicals, and a telephone line connecting them to the surface. Beebe's encounters with new forms of life during their numerous dives left him fascinated by the wonders they uncovered. He even witnessed a "creature, several feet long, dart toward the window, turn sideways and—explode." The flash was so intense that it illuminated his face, revealing a great red shrimp and an outpouring of fluid in flame. Despite the risks involved, Beebe demonstrated exceptional naturalist skills, as well as a cool-headed scientific approach. He once called for rapid descent when water began to steam rapidly into the sphere during a deep dive, hoping that increasing pressure would force the leaking window back into its seals and stop the leak. His plan worked, showcasing his impressive knowledge of basic physics. As they descended to their record depth, the volume of the bathysphere decreased by how much? (Treating it as a solid metal sphere for simplicity.) A. 9.0 × 10−5 m3 B. 9.2 × 10”5 m3 C. 1.1 × 10−4 m3 D. 3.8 × 10−4 m3 One day, he witnessed a "creature" that was several feet long, which darted toward the window, turned sideways, and then exploded. The flash from the explosion illuminated his face, revealing the great red shrimp and the outpouring of flame. This experience led him to think that the ocean depths were as mysterious as those on Mars. However, deep-sea diving came with its risks. Sometimes, the bathysphere would return to the surface partially filled with water after a window seal failed. During one dive, water began to steam rapidly into the sphere, causing Beebe to quickly call for assistance. By asking the crew to lower him down instead of raising him up, he hoped that increasing the water pressure would force the leaky window into its seals and stop the leak. Beebe's quick thinking demonstrated not only his exceptional naturalist skills but also his cool-headedness as a scientist with a good understanding of basic physics.